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Research Product 89-09

Catalogue of MANPRINT Methods

February 1989

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MANPRINT Coordination Office
Systems Research Laboratory

U.S. Army Research Institute for the Behavioral and Social Sciences

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U.S. ARMY RESEARCH INSTITUTE
FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency Under the Jurisdiction of the Deputy Chief of Staff for Personnel

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This catalogue consists of descriptions of current and forthcoming MANPRINT methods developed by the Army Research Institute (ARI) or by ARI along with another agency. The methods are categorized as currently available or anticipated, with date of availability included. Each method is described in terms of the aspect of MANPRINT for which it is appropriate; the equipment necessary for using it; the input, processing, and output of the method; the use of the output; the stage of development; and how to obtain it. Reference and alternative or comparable approaches are provided when available.

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Research Product 89-09

Catalogue of MANPRINT Methods

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February 1989

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Human Factors in Training
Operational Effectiveness

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FOREWORD

The goal of the Army's Manpower-Personnel Integration (MANPRINT) program is to influence design and fielding of new weapon and other systems to improve battlefield effectiveness and reduce operations and support (O&S) costs. This is done by analyzing soldier performance throughout the design of the new system. ARI's Systems Research Laboratory develops design and performance analysis methods and tools for combat, training, and materiel developers. A number of analysis method and tool prototypes have been demonstrated successfully in the Light Helicopter Family-Experimental (LHX), Forward Area Air Defense (FAAD), and Aerial Target Handover System (ATHS) developments. To make these and other MANPRINT tools more widely available, descriptions of their purposes, limitations, and other information relevant to users have been collected in this catalogue.

This catalogue has been reviewed, accepted, and briefed to representatives of TRADOC, AMC, and other Army agencies with MANPRINT responsibilities. To document progress in MANPRINT analysis method development, this catalogue will be revised annually.

EDGAR M. JOHNSON
Technical Director

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CATALOGUE OF MANPRINT METHODS

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CATALOGUE OF MANPRINT METHODS

Introduction

This Catalogue of MANPRINT Methods consists of abbreviated descriptions of those methods that the Army Research Institute (ARI) has developed, has significantly participated in the development of, or is in the process of developing. The purpose of this catalogue is to assist those involved in the MANPRINT effort in selecting the appropriate MANPRINT design and analysis methods.

The methods in this catalogue are broadly categorized by their availability, i.e., currently available or available at a future date (with the date specified). Within those two broad categories, the methods are presented in their format (analytical technique, handbook, or computer software) in alphabetical order. The description of each method consists of brief discussion of the aspect(s) of MANPRINT for which it is appropriate; the equipment necessary for using the method; the input, processing, and output of the method; and the use of the output. References for the method are given as well as alternative or comparable approaches, the stage of development of the method, how to obtain it, and comments.

ARI wants this catalogue to be a working document, one that is useful in the task of applying the MANPRINT principles not only to the concept development phase of system acquisition, but also to its actual design. We would appreciate your comments regarding your experience with this document and with the overall MANPRINT effort. Send your comments to Commander, U.S. Army Research Institute, ATTN: PERI-SZM, 5001 Eisenhower Avenue, Alexandria, Virginia 22333-5600. As we at ARI enlarge our experience with the methods and with MANPRINT and receive information from others in the MANPRINT community, we will develop a "lessons learned" document so that all can benefit from one another's efforts, be they successful or not-so-successful. Additionally, this document will be updated to include additional ARI MANPRINT methods and significant changes in the status of reported methods.

Currently Available Analytical Technique

Hardware vs. Manpower (HARDMAN)

1. OWNERSHIP: Government

2. POC: Dr. Uldi Shvern

3. PHONE: Autovon: 284-8914 Commercial: (703) 274-8914

4. DESCRIPTION:

a. HARDMAN is an analytic approach for early manpower, personnel, and training (MPT) estimation based on a technique which uses knowledge about similar existing systems and technological growth trends to project the MPT requirements of proposed new systems.

b. This method is appropriate for developing a structured comparability analysis. HARDMAN is most useful in the development of systems, but may be applied to product improvement program (PIP) systems as well as non-developmental item (NDI) systems. It is most useful pre-milestone I; however it has utility through milestone III.

c. The equipment required for this method is a calculator (at the minimum) or preferably a PC, (especially for multiple applications or large systems).

d. The input for this method includes:

- missions
- equipment
- functions and subfunctions
- usage rates
- reliability and maintainability (RAM) data
- transients, trainees, holdees, and students (TTHS) data
- promotion, attrition, migration data
- training data.

e. The processing of the input involves data conversions to an appropriate format for use with a calculator or PC.

f. The output from this method includes:

- an estimation of workload.
- manpower requirements by military occupational specialty and paygrade.
- personnel flow rates
- training resource requirements.

g. The output is used to project MPT requirements and especially to identify potential problem areas.

6. REFERENCES:

a. U.S. Army Research Institute for the Behavioral and Social Sciences (1985). HARDMAN comparability analysis methodology guide (5 Vols ARI Research Product 85-19 through 85-23; AD A 156787 through AD 156791, May).

b. Zimmerman, W., Butler, R., Gray, V., Rosenberg, L., & Risser, D. (1984). Evaluation of the HARDMAN (Hardware vs. Manpower) comparability methodology (ARI Technical Report 646, August).

7. ALTERNATIVE OR COMPARABLE APPROACHES:

HARDMAN II (Man Integrated Systems Technology (MIST)).

8. STAGE OF DEVELOPMENT OF METHOD:

This method is fully mature in that it has been applied to about 20 Army systems. Those systems include: DSWS, CSWS, ESPAWS, ASAS, AGS, Hawk, (PIP-III), Air Defense Systems, ETAS, STINGRAY, LADS, LHX, Patriot, SGT York, SHORAD C2, AFATADS, LRAT, and FAALS.

9. HOW TO OBTAIN:

a. The HARDMAN Guide is available from the Defense Technical Information Center.

b. Documentation of HARDMAN utility can be obtained from the Soldier Support Center - National Capital Region (SSC-NCR). The point of contact there is Bernard Schuster, (202) 325-2093.

10. COMMENTS:

a. The approximately 20 applications of the HARDMAN method have been performed by contractor consultants.

b. The cost to use this method for a single system is approximately three person-years, but varies according to a number of factors including system size, system complexity, accessibility of data, experience of analysts, and scope of analysis, etc.

c. The method is manual.

d. A fairly large (more than ten) team of interdisciplinary analysts is required at various times throughout the analysis.

e. Data collection is often difficult and time-consuming. Cost of data collection can be 40% of total cost of a HARDMAN analysis, depending on data accessibility.

f. Trade-off analyses take considerable time.

g. The value of HARDMAN is very high if results are used in making MPT decisions.

h. HARDMAN has undergone a product improvement program (PIP) which was completed in December 1987. That PIP expands the scope of the MPT topics addressed by the earlier HARDMAN and more explicitly defines the procedures to be used in making various judgements and decisions. To receive a copy, contact: Commander, U.S. Army Research Institute, ATTN: PERI-SM (Dr. Shvern) 5001 Eisenhower Ave., Alexandria, VA 22333-5600.

Currently Available Handbooks

Embedded Training (ET) Guidelines and Procedures

1. OWNERSHIP: Government

2. POC: Ms. Dorothy L. Finley

3. PHONE: Autovon: 284-8876 Commercial: (703) 274-8876

4. DESCRIPTION

a. This body of work provides the "how to" procedures and guidelines for developing ET, and source materials which provide information and examples of ET development documentation.

b. The method is appropriate for the MANPRINT domain of training in all stages of development cycle and for all milestones.

c. No equipment per se is necessary; however, a data base management system for manipulating task data would be of considerable assistance.

d. The inputs necessary for this method are all available information on:

- the missions to be performed
- the tasks to be performed
- the soldier-machine interface
- comparable systems.

e. The processing techniques used on the input data vary as a function of the objective to be achieved. The technique per each objective is specified in the guideline and procedures volume pertaining to that objective.

f. The output consists of:

- decisions regarding the feasibility of incorporating ET into the system.
- how ET is integrated into and implemented in the system.

g. The output is used in identifying the need for designing, and developing ET. The ET guidelines and procedures apply to relevant events and products produced by training developers, combat developers, materiel developers, testers, and contractors.

5. REFERENCES:

An extensive list of ET references is given in Vol 1, Overview, of the ET guidelines and procedures.

6. ALTERNATIVE OR COMPARABLE APPROACHES:

There are no other approaches published for the design of ET. The TRADOC Systems Approach to Training (TRADOC Reg 351-7) addresses development of general training strategies.

7. STAGE OF DEVELOPMENT OF THE METHOD:

The method is in its final stages of development with nine of ten guidelines and procedures documents already reviewed or in the process of undergoing review by TRADOC. The final publication dates for the ten volumes are:

Vol. 1, Overview	January 1988
Vol. 2, ET as a System Alternative	February 1988
Vol. 3, Roles of ET in the Training System Concept	February 1988
Vol. 4, Identifying the ET Requirements, Revised	February 1988
Vol. 5, Designing the ET Component, Revised	March 1988
Vol. 6, Integrating ET with the System	May 1988
Vol. 7, ET Test and Evaluation	April 1988
Vol. 8, Incorporating ET into Army Unit Training	March 1988
Vol. 9, Logistics Implications	April 1988
Vol. 10, Integrating ET into Acquisition Documentation	April 1988

8. HOW TO OBTAIN:

Requests for documentation, an introductory video tape, or access to an ET electronic bulletin board should be addressed to either one of the following:

USARI
ATTN: PERI-SM (Dr. Alderman)
5001 Eisenhower Ave.
Alexandria, VA 22333-5600
AV: 284-9134
(703) 274-9134

PM TRADE
ATTN: AMCPM-TND-ET (Mr. Peckham)
NTC-Orlando, FLA 32813-7100
AV: 791-5771/5881
(305) 646-5771/5881

9. COMMENTS:

a. ET has been mandated as the first alternative to be considered for any new system, regardless of the acquisition strategy, and to be a part of the MANPRINT, and the integrated logistics support (ILS) programs.

b. The ten guidelines and procedures documents are based on experience with the development or evaluation of seven Army systems and a number of other studies, many of which have been completed. The seven Army systems are: FOG-M, HIP, Sgt York, MCS-2, ASAS, FAAD NLOS, and the AFV.

c. The cost of the front end analysis necessary for ET requirements analysis and design concept development ranges from 30K to 500K with an average of 100K or one PSY.

d. Acquiring the resources to apply the method is an issue. If the Instructional Systems Development and Systems Approach to Training (ISD and SAT) and MANPRINT approaches are being effectively applied, the ET effort is a small additional cost.

e. From the beginning of the development of a materiel system, the operational and organizational (O&O) plan, the required operational capability (ROC), as well as the request for proposals (RFPs) for the materiel system must include provisions for possible ET. Otherwise, preliminary designs may lack the computer, control, and display capacity and flexibility to permit later ET incorporation.

MANPRINT in Test and Evaluation

1. OWNERSHIP: Government

2. POC: Mr. John Miles

3. PHONE: Autovon: 284-8917 Commercial: (703) 274-8917

4. DESCRIPTION:

a. The method consists of two equations for predicting manned system performance, given sample data which describes soldier performance and hardware and software reliability. The first equation calculates the "effectiveness" of the manned system by a numerical answer to the question "How well does the system work when it works?" The second equation uses operating times for the seven maintenance tasks described in MIL-STD-721 as well as values for operating time, standby time, corrective and preventive maintenance times, and administrative and logistic down time to calculate the availability of the manned system (or the numerical answer to the question, "How often does the system work?"). The document explains the construction of the two equations, and provides details of calculating the soldier performance terms in each equation together with illustrations.

b. This method is appropriate for planning a full-scale MANPRINT evaluation of a soldier-machine system. All six MANPRINT domains are addressed, and performance effects of those six domains can be calculated. The reference (paragraph 6 below) contains both explanation and example.

c. The equipment required to use this method are photocopies of the worksheets from the reference (paragraph 6 below).

d. The inputs necessary for this method are:

- soldier performance data (time and accuracy) of critical operations and maintenance tasks
- soldier aptitude data (ASVAB Profile)
- training data: time, cost, and end-of-training comprehension test scores
- human factors engineering analysis
- safety assessment report
- health hazard assessment report.

e. The processing of the input is the completion by hand of the worksheets from the reference (paragraph 6 below).

f. The output consists of:

- probabilities of correct soldier performance of each critical operations and maintenance task within time constraints.
- probability of correct soldier performance of all critical operations and maintenance tasks within time constraints .
- system effectiveness (including soldier performance) prediction expressed as a probability.
- system availability (including soldier performance) prediction expressed as a probability.

g. The output of this method is used to evaluate quantitatively how well and how often a soldier-machine system will work in the field.

6. REFERENCE:

Lowry, J. and Seaver, D. (1986). Handbook for quantitative analysis of MANPRINT considerations in Army systems (Technical Report 86-1, June). Alexandria, VA: Allen Corporation of America.

7. ALTERNATE OR COMPARABLE APPROACHES:

a. Scott, J. et al., Task aptitude template: a MANPRINT methodology for identifying aptitude-sensitive critical tasks (Draft Report 1987, June). San Diego, CA: Cubic Defense Systems, Inc.

b. Human Resources Test and Evaluation System (HRTES)

(1) Kaplan, J., Crooks, W., Sanders, M., and Dechter, R. (1984). Human resources test and evaluation system (HRTES) comprehensive handbook (ARI Research Note 84-119 (AD-A165752), August).

(2) Kaplan, J., Crooks, W., Sanders, M., and Dechter, R. (1984). Human resources test and evaluation system (HRTES) comprehensive workbook (ARI Research Note 84-120 (AD-A165812), August).

8. STAGE OF DEVELOPMENT OF METHOD:

Completed.

9. HOW TO OBTAIN:

a. Army Research Institute (ARI) employees may request photocopy from the Manned Systems Group, Systems Research Laboratory, ARI.

b. Non-ARI employees may request ADA 199620 (ARI RP-8815) from Defense Technical Information Center (DTIC) Cameron Station, Alex., VA 22304-6145 Phone: AV: 284-7633 Commercial: (703) 274-7633.

10. COMMENTS:

a. The reference cited in paragraph 6 above is a contractor's product in the contractor's format. As such, it is complete and ready-to-use. Publication in ARI format (as a research product) is planned for 1988.

b. The document cited in paragraph 7a addresses two of the six MANPRINT domains, those of personnel and training. The intent of that document is to identify which critical tasks of a developing system show performance differences as a function of soldier aptitude and training. This document is in an early draft and is scheduled for completion in July 1988.

c. The documents cited in paragraph 7b describe the predecessor methodology (HRTES) which was prepared for essentially the same purpose and scope. HRTES uses multi-attribute utility theory to calculate value scores for various human resources parameters. HRTES is considered both labor-intensive and resource-intensive. Both of the documents in paragraph 7b are complete and are available through the Defense Technical Information Center (DTIC).

Currently Available Computer Software

Army Manpower Cost System (AMCOS)

1. OWNERSHIP: Government

2. POC: Dr. David K. Horne

3. PHONE: Autovon: 284-5610 Commercial: (703) 274-5610

4. DESCRIPTION:

a. AMCOS is a user-friendly, PC-based family of manpower cost models used to forecast manpower costs for the life cycle of a new or proposed weapon system. The models incorporate data from a variety of sources and compute cost elements, such as military compensation, recruiting, training, and medical support for each military occupational specialty (MOS). These cost elements are then incorporated into a life-cycle cost estimating routine. The model generates the manpower costs for the life cycle of the system, by year, for each MOS as well as for the entire system.

b. This method is appropriate for costing manpower requirements during system development.

c. The equipment required to use this method is an IBM compatible PC.

d. The input for this method consists of:

- manpower by grade by MOS.

e. The processing of the information specifies manpower requirements by pay grade for each MOS for up to a 30 year life-cycle. MOS-specific and total costs are generated in a matter of seconds.

f. The output is:

- manpower costs by MOS by year and budget appropriation category.

g. The output is used to develop the most cost-efficient system, and develop the cost effective manpower and hardware configuration for the system. In addition, the output is used to choose the most efficient manpower mix and cost changes in personnel policies, and estimate budget costs of personnel policies.

5. REFERENCES:

U.S. Army Research Institute for the Behavioral and Social Sciences. (1987). Army Manpower Cost System (AMCOS) (ARI Research Focus, June, No. 5).

6. ALTERNATIVE OR COMPARABLE APPROACHES:

Navy Billet Cost Model

7. STAGE OF DEVELOPMENT OF METHOD:

The enlisted component life cycle cost models currently is available.

8. HOW TO OBTAIN:

Contact POC, Dr. David K. Horne, by telephone or write to Commander, U.S. Army Research Institute, ATTN: PERI-RG (Dr. Horne), 5001 Eisenhower Avenue, Alexandria, VA 22333-5600.

9. COMMENTS:

Since the program can be executed in about 45 seconds on a PC, there is no real cost of running the software.

Electronic Aids to Maintenance (EAM) Impact on Weapon System Availability

1. OWNERSHIP: Government

2. POC: MAJ Charles J. Hintze

3. PHONE: Autovon 284-8917 Commercial (703) 274-8917

4. DESCRIPTION:

a. The method resides on an IBM compatible PC computer disk. Currently there is no user documentation; however, analysts experienced in LOTUS 1-2-3 should have little difficulty applying the method to other weapon systems and support concepts.

b. This method is appropriate for use during the weapon system acquisition process from concept development through full scale development as well as during doctrine development. The model can be used to determine the level of performance of built in test (BIT) and built in test equipment (BITE) necessary to attain a specified level of weapon system availability or to determine where opportunities lie to improve weapon system performance by changing BIT and BITE performance, maintenance doctrine, or policy.

c. The equipment required to use this method is an IBM compatible personal computer and LOTUS 1-2-3 software.

d. The input for this method consists of:

- reliability, availability and maintainability (RAM) data: mean time between failure, and mean time to repair.
- administrative and logistics delay data: transit times between maintenance and supply levels, proportional distribution of supply and maintenance events among the various levels from user through CONUS depot, and supply delays attributable to each level.
- mission data: weapon system density, weapon system utilization rates, and duration of continuous weapon system employment.
- EAM Hypotheses (actual data may be used if known) concerning the portion of the weapon system monitored and tested by BITE, and BITE reliability in terms of the ability to identify faults accurately, the ability to complete the isolation process, and the ability to isolate a fault to the correct component.

e. The processing of the input involves the computation of the maintenance and delay time for each location (node) of the maintenance and supply support system for a single maintenance event. The expected values for a single event are then extrapolated to cover the number of weapon

systems employed in the mission profile over the specified period. The extrapolated values are compared against the total mission duration to determine weapon system availability.

f. The output from this method consists of:

- weapon system availability.
- average not-mission-capable time for all reasons.
- probability of remedial maintenance action due to BITE failure at each node of the support system and for the entire support system.
- time spent in transit for the performance of remedial maintenance action to and from each node, and total remedial maintenance transit time for the support system.
- not-mission-capable time attributable to each supply source which includes controlled substitution and the cases where no parts are required.

g. The output is used to indicate the degree to which weapon system availability goals will be accomplished by a given set of support data and the degree to which BITE reliability detracts from availability. Additionally if a regression analysis is performed, the sensitivity of weapon availability to each of the support nodes can be determined, thereby identifying the potential support system improvements (including but not limited to BITE) that are most lucrative in terms of improvement in weapon system availability.

5. REFERENCES:

Draft report "Analysis of electronic aids to maintenaince, for LHX"

6. ALTERNATIVE OR COMPARABLE APPROACHES:

Administrative and Logistics Delay Time analyses.

7. STAGE OF DEVELOPMENT OF METHOD:

The method has been applied to the family of light helicopters (LHX) and as such is complete for a support environment with a two level maintenance system and multi-level supply system.

8. HOW TO OBTAIN:

Contact the Commander, U.S. Army Research Institute, ATTN: PERI-SM (MAJ Hintze), 5001 Eisenhower Avenue, Alexandria, Virginia 22333-5600.

9. COMMENTS:

a. The cost of use of this method is minimal assuming the availability of an IBM compatable PC and LOTUS 1-2-3 software. All input data are generally available either from historical data for existing systems or from the concept development process for emerging systems. The set up and run time is less than one hour for the initial application and less than fifteen minutes for subsequent iterations.

b. The outcomes of this method are useful to doctrinal or weapon system development, and for the selection of non-developmental item systems in that they facilitate tradeoff analyses among design characteristics that drive RAM data, BITE, support concepts, and the relative placement of support units and the specialists within those units on the battlefield.

c. The method is effective in identifying the impacts of BITE reliability on the time required to isolate and repair a fault. A natural progression of the method is to incorporate the degree to which BITE induces system failures.

HARDMAN II (also known as Man-Integrated Systems Technology (MIST))

1. OWNERSHIP: Government

2. POC: Dr. Uldi Shvern

3. PHONE: Autovon: 284-8914 Commercial: (703) 274-8914

4. DESCRIPTION:

a. HARDMAN II is a computer-based analytic approach for early manpower, personnel, and training (MPT) estimation based on a technique which uses knowledge about similar existing systems and technological growth trends to project the MPT requirements of proposed new systems.

b. This method is appropriate for early MPT estimation based on comparability analysis. HARDMAN II is most useful in system development, but also is useful in a product improvement program (PIP) and for a non-developmental item (NDI) acquisition. It is most useful pre-milestone I, although it applies up to milestone III.

c. The equipment required for this method is:

- Vax - 11 (any model)
- VMS 4.1 (or later version) FMS 2.2
- tape drive
- printer
- terminal (VT 100 or emulator).

d. The input for this method consists of:

- the mission
- equipment
- functions and subfunctions
- usage rates
- reliability, availability, and maintainability (RAM) data
- transients, trainees, holders and students (TTHS) data
- promotion, attrition, migration data
- training data.

e. The processing of the input involves multiple computer runs. Computations and formatting of reports are performed automatically.

f. The output from this method is an estimation of:

- workload, manpower requirements by military occupational specialty and paygrade
- personnel flow rates
- training resources requirements.

g. The output is used to project MPT requirements, especially to identify potential problem areas and to evaluate trade-offs.

5. REFERENCES:

a. Herlihy, D. (1985). Man-Integrated Systems Technology user's guide Wilmington, MA: Dynamics Research Corporation, October.

b. Herlihy, D. (1985). The first application of the Man-Integrated Systems Technology to an emerging weapons system - findings Wilmington, MA: Dynamics Research Corporation, October.

6. ALTERNATIVE OR COMPARABLE APPROACHES:

Hardware vs. Manpower (HARDMAN).

7. STAGE OF DEVELOPMENT OF METHOD:

This method is fully mature in that it has been applied to several Army systems including the Light Air Defense System (LADS) and SHORAD C^2. Documentation of utility exists.

8. HOW TO OBTAIN:

HARDMAN II software and User's Guide are available from Commander, U.S. Army Research Institute, ATTN: PERI-SM (Dr. Shvern), 5001 Eisenhower Ave., Alexandria, VA 22333-5600.

9. COMMENTS:

a. The cost of applying this method is approximately two and one-half person-years for a large system, but varies with system size, system complexity, accessibility of data, experience of analysts, scope of analysis, etc. Cost of the data collection can be as much as half of the total effort if accessibility to the data is difficult. Cost can be significantly lower if only a portion of the MIST analysis needs to be performed.

b. HARDMAN II potentially is valuable if results are used in making MPT decisions.

c. A fairly large (ten plus) team of interdisciplinary analysts is required. Teams include engineers, training analysts, a manpower analyst, a force structure analyst, a decision analyst, and an analysis manager. Usually, at least one team member will have had extensive military experience with the type of system being analyzed.

d. Data collection is often difficult and time-consuming, but is the same as for HARDMAN.

e. An independent evaluation of HARDMAN II, which was completed in the fall of 1987, assessed the ease of use of HARDMAN II and the need for additions or changes to the model.

Human Operator Simulator (HOS IV)

1. OWNERSHIP: Government

2. POC: Dr. Jonathan D. Kaplan

3. PHONE: Autovon: 284-8873 Commercial: (703) 274-8873

4. DESCRIPTION:

a. HOS IV is a partially menu driven, simulation-based approach to evaluate soldier-machine interface design. It can be used at any stage of the design process. The output from HOS IV can be used for interface design evaluation as part of the iterative design process. HOS IV predicts both operator and full system performance. Previous mainframe versions of HOS were developed by the U.S. Navy.

b. The method is appropriate for use in any stage of the design process of new acquisitions; or in the evaluation process of new acquisitions, product improvements, and non-developmental acquisitions. The user of HOS IV must have detailed information about the system to be modeled. This information can be notional; it can be based on predecessor systems; or it can be based on preliminary, intermediate, or final versions of the system. Whatever the source, this information must include detailed knowledge or speculation on: the interface design, the sequence of soldier-machine interactions, and the system environment.

c. The equipment required for HOS IV is an IBM AT or equivalent computer. That computer must have:

- enhanced graphics display
- enhanced graphics board with 256 KB of RAM
- hard disk with a minimum of 20 megabytes of storage
- a minimum of one megabyte of enhanced memory
- 80287 coprocessor chip for intensive floating point computations
- Mouse
- DOS 3.1 OR 3.2
- Microsoft C 4.0.

d. The input necessary for HOS IV is:

- a notional, preliminary, or final soldier-machine interface design and task analysis.

e. The processing of the information involves the running of a simulation model of the operator and system.

f. HOS IV output includes:

- mean time per procedure
- numbers of errors per procedure
- number of times each procedure was invoked
- proportion of operator's time per procedure
- timelines
- design and task causes of specified system performance shortfalls.

g. The output may be used to evaluate interface designs. HOS IV can be used by MANPRINT personnel either to predict manned system performance or determine whether performance will reach criterion levels.

5. REFERENCES:

Banowetz, V., and Iavecchia, H., (1981). A human operator simulator model of the advanced signal processor (DICASS) processing (Technical Report 1400.09). Willow Grove, PA: Analytics.

Harris, R., Glenn, F., Iavecchia, H., Nothenheber, E., and Zaklad, A. (1986). HOS-IV specifications (Technical Report 1800.28B). Willow Grove, PA: Analytics.

Human operator data analyzer/collator (HODAC) user's/programmer's guide (1982) (Technical Report 1400.22D). Willow Grove, PA: Analytics.

Human operator simulator study guide (1982) (Technical Report 1400.22C). Willow Grove, PA: Analytics.

Ross, L. and Harris, R. (1985). HOS-IV hardware evaluation and specifications (Technical Report 1800.36B). Willow Grove, PA: Analytics.

6. ALTERNATIVE OR COMPARABLE APPROACHES:

There are no fully comparable approaches to HOS IV's combination of user friendliness and human processing micro-models. An alternative approach would require the use of a modeling language such as SLAM II, Micro Saint, GASP, or Simscript, to build a system simulation; and four human processing models that would serve as components within that simulation. Another alternative approach would require the building of a system interface mockup or prototype to be used to collect user performance data.

7. STAGE OF DEVELOPMENT OF METHOD:

HOS IV is currently available.

8. HOW TO OBTAIN:

Contact the POC, Dr. Jonathan Kaplan by telephone or write to Commander, U.S. Army Research Institute, ATTN: PERI-SM (Dr. Kaplan), 5001 Eisenhower Avenue, Alexandria, VA 22333-5600.

9. COMMENTS:

a. HOS IV provides highly useful predictions of manned system performance. However, it should be understood that creating a simulation using HOS IV will require a thorough understanding or detailed concept of the proposed system to be simulated.

b. The cost of entering the data, running HOS IV and interpreting the output is driven largely by the time required to obtain the data. When the data come from another organization and are difficult to obtain, the estimated total cost is one-half professional staff year.

Job Assessment Software System (JASS)

1. OWNERSHIP: Government

2. POC: Dr. Sue Bogner

3. PHONE: Autovon: 284-9420 Commercial: (703) 274-9420

4. DESCRIPTION:

a. JASS is a computer-based technique that allows weapon systems designers to estimate the aptitude requirements (cognitive, perceptual and psychomotor) of operations and maintenance tasks.

b. This method is appropriate for use in addressing issues in the MANPRINT personnel domain. JASS is useful to estimate aptitude requirements of new systems and to compare with requirements of predecessor systems when job or tasks are defined at a general or detailed level. A taxonomy of 40 aptitudes have been selected (these are not in AVSAB terms). JASS is applicable to all stages of the acquisition process; however, the data are more useful as tasks are more well defined.

c. The equipment required to use this method is:

- Apple II with 48K memory
- two disk drives
- a monitor
- Apple DOS 3.3 disc operating system.

d. The input necessary for this method is:

- subject matter expert (SME) judgements of the abilities needed for the job or tasks under consideration.

e. The processing of the input consists of summarizing the input information.

f. The outputs of JASS are:

- predicted aptitudes and levels of each aptitude required.

g. The output is used to provide estimates of aptitudes required of jobs or tasks for the purpose of identifying excessively high aptitude requirements.

5. REFERENCES:

Rossmeissl, P.G.; Tillman, B.W.; Rigg, K.E.; and Best, P.R. (1983). Job Assessment Software System (JASS) for analysis of weapon system system personnel requirements (ARI-RR: 1355, November).

6. ALTERNATIVE OR COMPARABLE APPROACHES:

There are no known alternative or comparable approaches.

7. STAGE OF DEVELOPMENT OF THE METHOD:

JASS is partially mature in that the method has been in the field, but no formal assessment of its utility is available.

8. HOW TO OBTAIN:

Contact the POC, Dr. Sue Bogner, by telephone or write, Commander, U.S. Army Research Institute, ATTN: PERI-SZM (Dr. Bogner), 5001 Eisenhower Ave., Alexandria, VA 22333-5600.

9. COMMENTS:

a. Pilot data have been collected on helicopter pilots and maintenance personnel.

b. Reliability of the output is dependent on the number of SME raters and their knowledge of the jobs or tasks being rated.

Operations and Maintenance Requirements Simulation Methodology and Model

1. OWNERSHIP: Government

2. POC: MAJ Charles J. Hintze

3. PHONE: Autovon: 284-8917 Commercial: (703) 274-8917

4. DESCRIPTION:

a. The method dynamically simulates and links system mission capability with system maintenance and supply support concepts and resources. The method may be applied in two major ways: (1) required manpower workloads can be determined for a given reliability, availability and maintainability (RAM) goals, system mission requirements (scenarios), and MARC (manpower requirements criteria) or MACRIT (manpower authorizations criteria) factors; and (2) system mission availability and duration can be determined for a given manpower availability, MARC or MACRIT factors and RAM capability.

b. The model is a stand-alone component of the MANPRINT Mission Capability (MANCAP) model which is currently configured for use only in the light family of helicopters (LHX) program. The operations and maintenance simulation model links manpower to the LHX sortie generation capability of a light infantry division combat aviation brigade as a function of RAM and military occupational specialty (MOS).

c. A PC-compatible version with limited user documentation is available. (Turbo Pascal version 4.0 is required.) Many of the processes and results of this semi-interactive simulation have been represented by spreadsheet and graphical aids.

d. Input is usually obtained from the operational and organizational plan, RAM rationale report and mission scenarios, and consists of:

- mission operational performance profiles by numbers and types of systems to be committed.
- operational mission timing, sequencing, and duration; system RAM parameters.
- system maintenance and sustainability MARC or MACRIT assumptions.
- system organization for mission performance in terms of personnel and materiel strength and composition information.

e. The processing of the input is based on an event store simulation concept. The simulation develops event information based on anticipated mission profiles. These events which are stored as string variables packed with event transaction information, serve as a "genetic code" for the model and control the model program timing and behavior. Systematic variation of MOS availability and other parameters over successive "runs" of the simulation may be used to relate MOS presence for duty to system mission capability.

f. The output from this method consists of:

- system operational down times due to delays in support system reaction.
- delays in support system reaction by MOS, echelon, and workload priority.
- combat and non-combat mission maintenance and supply workloads by MOS and echelon.
- mission capability stated in terms of systems available to start the mission together with their expected operational duration.

g. The output may be used to quantify and study the relationships between hardware design, manpower availability, personnel capability, and mission capability.

6. REFERENCES:

Draft report "LHX MANCAP application to the Light Infantry Division".

7. ALTERNATIVE OR COMPARABLE APPROACHES:

a. RAM Rational Report.

b. Hardware vs. Manpower (HARDMAN).

8. STAGE OF DEVELOPMENT OF METHOD:

The model being developed for LHX is in the prototyping stage. With minor training, Army users could apply it interactively for LHX analysis.

9. HOW TO OBTAIN:

Contact the Commander, U.S. Army Research Institute, ATTN: PERI-SM (MAJ Hintze) 5001 Eisenhower Avenue, Alexandria, VA 22333-5600.

10. COMMENTS:

a. The cost of using this method depends on the existence and availability of data about the system under consideration. It is believed that all relevant data may be acquired and assembled within three person months. When the simulation is system-configured, loading of the baseline data may be interactively completed within 20 minutes. Simulation time is related to the number of systems desired per mission, number of missions per unit, and the number of units per operational cycle.

b. This simulation is a top-down method that complements other methods such as HARDMAN which takes an evolutionary, bottom-up approach.

c. The method is sensitive to on-hand materiel; RAM and integrated logistics support parameters; MOS availability and capability; doctrinal system support configuration; and operation mission loading by numbers, timing, and duration of systems and personnel committed.

Supply Support Methodology and Model

1. OWNERSHIP: Government

2. POC: MAJ Charles J. Hintze

3. PHONE: Autovon: 284-8917 Commercial: (703) 274-8917

4. DESCRIPTION:

a. This method estimates the supply manpower and personnel required to support a given mission profile for any emerging weapon system. The analysis can be applied to any supply operation including repair parts, fuel resupply, and ammunition resupply; and can be applied throughout the acquisition cycle from initial concept development through full scale development. The method can be applied to assess the impact of a change in system operation on system supportability, or to assess the impact of a change in supportability on system operability.

b. The model is a stand-alone component of the MANPRINT Mission Capability (MANCAP) model which is currently configured for use only in the light family of helicopters (LHX) program. The model consists of separate sub-modules for fuel (Class III), ammunition (Class V), and repair parts (Class IX) supply. Each sub-module uses a LOTUS 1-2-3 spreadsheet to determine the amount of Class III, V or IX resources required to support the LHX's operating conditions. Given the total supply resources and any doctrinal constraints, the total LHX Class III, V and IX manpower is then determined.

c. The equipment required to use the model is an IBM PC compatible computer and LOTUS 1-2-3 software.

d. The input for this method consists of:

- mission profile.
- average mission duration.
- average number of missions per day.
- system support requirements such as supply resources required, resource consumption rates, system capacity, and doctrine support requirements.
- supply support requirements such as supply support equipment.

e. The processing of the input determines the amount of supply resources required to support the system's operating conditions. Given the total supply resources required to support sustained operating conditions, the numbers and types of people for continuous support of the system; operational requirement is then determined for specific doctrinal requirements. Also, by varying the placement of supply support equipment to optimize the numbers or

types of personnel required to maintain continuous support of the system, sensitivity analyses can be processed.

f. The output consists of:

- supply support resource requirements to support mission profile
- manpower supply support requirements
- number and types of supply support equipment required.

g. The output from this method can be used either as a planning tool to estimate the supply support required to maintain a given operating scenario or as a technique to evaluate the effects of support activities on mission availability. The output of the analysis is useful to the planners of the weapon system development in that it provides a method by which the supportability of a developing system can be evaluated or re-evaluated using limited system information.

5. REFERENCES:

Draft report entitled "LHX MANCAP application to the Light Infantry Division".

6. ALTERNATIVE OR COMPARABLE APPROACHES:

a. Selected Essential-item Stockage for Availibility Method (SESAME) model

b. Early comparability analyses (ECA)

7. STAGE OF DEVELOPMENT OF METHOD:

The method has been applied to the Army's acquisition program for the LHX. Specifically, the analysis was applied to assess the Class III, Class V, and Class IX supply requirements for LHX aircraft in a Light Infantry Division.

8. HOW TO OBTAIN:

Contact the Commander, U.S. Army Research Institute, ATTN: PERI-SM (MAJ Hintze), 5001 Eisenhower Avenue, Alexandria, VA 22333-5600.

9. COMMENTS:

The cost to use the method is driven by the cost to obtain the system data which is used as input to the model, assuming an IBM compatible PC and LOTUS 1-2-3 software are available. Once the required input is known, the set up and run time of the model is less than fifteen minutes with sensitivity runs processed in less than five minutes.

Currently Available Computer Simulation

Simulation Networking (SIMNET)

1. OWNERSHIP: Government Defense Advanced Research Projects Agency (DARPA)

2. POC: Dr. Barbara Black

3. PHONE: Autovon: 464-6928 Commercial: (502) 942-3845

4. DESCRIPTION:

a. DARPA currently is supporting a series of technology demonstrations referred to as simulation networking or SIMNET. DARPA selected the Abrams M1 tank and Bradley M2/3 fighting vehicles for the first demonstration of the application of both local area networking and distributed processing to interactive weapon system simulation. To date, modular crew compartments for a company team have been successfully networked to operate simultaneously on common simulated terrain.

b. This method is appropriate for addressing issues in the MANPRINT domains of manpower, personnel, training, human factors engineering, and safety. The most effective point in the Life Cycle Systems Management Model (LCSMM) for SIMNET-D to be used would be the concept exploration phase. In the case of the Army streamlined acquisition process (ASAP), the proof-of-principle phase would be the most useful for the application of SIMNET-D.

c. The equipment required to use this method is a SIMNET facility. The SIMNET-D primary facility is located at Fort Knox.

d. The input necessary for this method includes variables unique to:

- a particular system under test
- to a new experimental procedure
- to an exercise scenario all of which must be programmed for data capture.

e. The processing of the input occurs via two commercially available data capture and analysis software packages: Dataprobe and RS-1. Dataprobe is used to capture raw data from the simulators' ether net and create dependent variables. A finite number of dependent variables will be resident in the Dataprobe Dictionary based on the number and types of previous SIMNET-D experiments. RS-1 which is the analytic package available on SIMNET-D, can be used to conduct most standard parametric analyses as well as to create several varieties of graphs and charts. However, RS-1 does not include a multivariate capability which is almost a necessity for any normal size SIMNET-D effort.

f. The output from SIMNET-D is dependent upon the project, and the performance measures the analyst wants to collect and has stipulated in the Dataprobe package.

g. The output from SIMNET-D, may be used: 1) as quantitative or qualitative input for other MANPRINT methods or technologies or 2) as research product in and of itself which can be used as the basis for MANPRINT system decisions. A further use can be to cross-check or verify, on a limited empirical basis, assumptions of other methods or conclusions derived from them.

5. REFERENCES:

None.

6. ALTERNATIVE OR COMPARABLE APPROACHES:

None.

7. STAGE OF DEVELOPMENT OF METHOD:

The basic capabilities of the SIMNET-D currently are in place.

8. HOW TO OBTAIN:

Use of SIMNET facilities must be arranged through the process outlined in the DARPA-ARMY Memorandum of Understanding (MOU). It is anticipated that study groups and task forces wishing to use the facilities for major efforts will need to contribute two to three million dollars per effort. Other smaller scale concurrent uses may be arranged depending on priorities, feasibility, and availability considerations.

9. COMMENTS:

a. Excluding maintenance requirements, persons wishing to conduct research in SIMNET are expected to arrange for all necessary support, i.e., sufficient crews, platoons, companies, commanders and staffs, etc., as well as controllers, evaluators, and analysts.

b. One brief study has been completed as a proof-of-principle for the SIMNET-D data collection and analysis components. Several additional tests and evaluations should be completed during the balance of FY88 that will provide examples of how the SIMNET facilities can be used. However, a substantial number of important enhancements to SIMNET-D remain to be developed in the subsequent two to three year period.

c. Potential users should keep in mind that currently there is no empirical evidence to support the external validity or generalizability of test results obtained with SIMNET. There are plans to relate SIMNET outcomes and measures to those obtained with field exercises using engagement simulation, such as at the National Training Center. The validity and utility of SIMNET findings will rest on the professional judgment of military experts and analysts for the near future.

Future Handbooks

Addressing Manpower, Personnel, and Training (MPT) Issues in Human Factors Engineering Analysis (HFEA)

1. Ownership: Government

2. POC: Mr. John Miles

3. Phone: Autovon: 284-8917 Commercial: (703) 274-8917

4. DESCRIPTION:

a. The method consists of a flow-chart supplemented by narrative instructions explaining what the MPT issues are in the conduct of an HFEA and how to acquire and evaluate data on those issues.

b. This method is appropriate for preparing the manpower, personnel, and training portions of an HFEA. The reference (see paragraph 6) explains what data need to be acquired and suggests likely sources. Both theoretical and practical issues are discussed and illustrated in that reference.

c. The equipment required to use this method depends upon the data available. If no data are available, then only writing materials are involved. If data are available, then equipment for the application of statistical techniques is required (e.g., a calculator or PC).

d. The input necessary for this method consists of:

- soldier aptitude data (ASVAB Profiles)
- training data of time, cost, and end of training comprehension test scores
- soldier performance data of time and accuracy of performance of critical tasks.

e. The processing of the input depends upon the nature of the data. If no quantitative data are available, processing is restricted to logical analysis of anecdotal data. If quantitative data are available, the processing involves the effort to enter the data and the time for running statistical techniques.

f. The output from this method consists of:

- matrix of soldier performance related to ASVAB composite scores and training resources consumed.

g. The output is used to estimate system effectiveness and availability as a function of manpower, personnel, and training, and to determine the impact on Army personnel resources of fielding the system.

5. REFERENCE:

Guerrier, J. H., Lowry, J. C., Jones, R. E. Jr., Guthrie, J. L., Barber, J. L., and Miles, J. L. Jr. Handbook for conducting analysis of the manpower, personnel and training elements for a human factors engineering analysis (ARI Research Product in preparation October 1987).

6. ALTERNATIVE OR COMPARABLE APPROACHES:

A method for conducting "human factors engineering tests" of Army materiel is explained in:

Berson, B. L. and Crooks, W. H. (1976). Guide for obtaining and analyzing human performance data in a materiel development project, (Technical Memorandum 29-76, September). Aberdeen Proving Ground, MD: U.S. Army Human Engineering Laboratory.

7. STAGE OF DEVELOPMENT OF METHOD:

a. The final draft of the report containing this method currently is in peer review. Its estimated publication date is June 1988.

b. MPT portions of two unclassified HFEAs have been prepared using portions of this method:

(1) "Human Factors Engineering Analysis (HFEA) for the Remotely Piloted Vehicle (RPV) System." Aberdeen Proving Ground, MD: U.S. Army Human Engineering Laboratory, July 1987.

(2) "Human Factors Engineering Analysis (HFEA) for the NAVSTAR Global Positioning System (GPS), Milestone Decision Review (MDR) III." Aberdeen Proving Ground, MD: U.S. Army Human Engineering Laboratory, December, 1985.

8. HOW TO OBTAIN:

Until the final report is available through the Defense Technical Information Center (DTIC), copies of the draft may be obtained from Chief, Manned Systems Group, Systems Research Laboratory, Army Research Institute, 5001 Eisenhower Avenue, Alexandria, VA 22333-5600.

9. COMMENTS:

The handbook contains a noteworthy chapter on the theory of the Army's MANPRINT program.

Controlling Operator Workload in Army Systems Design and Evaluation

1. OWNERSHIP: Government

2. POC: Dr. Richard E. Christ

3. PHONE: Autovon: 978-4491/5297 Commercial: (915) 568-4491/5297

4. DESCRIPTION:

a. This ongoing exploratory program will develop and validate a practical method which will permit the estimation and evaluation of operator workload (OWL) in Army systems. The program focuses on the real world problem of determining what the Army can and should do to assure that its systems can be adequately operated by prospective well-trained Army personnel. The results of the program will be validated methods for OWL management and detailed user guidance in Army handbooks.

b. This method is appropriate for the areas of manpower, personnel, and training (MPT); however, there is potential to impact all six MANPRINT domains. This method will be applicable from early concept exploration through full scale production and deployment; it will have a greater impact on system design the earlier it is applied in the system acquisition process.

c. No equipment is required to access the guidance presented in the handbooks for estimating or evaluating OWL. However, the guidance itself will direct the user to employ an OWL assessment battery which, in turn, may require the use of techniques such as comparability analysis, time-line analysis, operator rating scales, or secondary task performance measures. Depending upon the resources available to the user, these techniques may range from paper-and-pencil exercises to very sophisticated computer driven analyses.

d. The input necessary from the user of the handbooks consists of:

- system characteristics and requirements
- characteristics of prospective system operators
- resources and capabilities available to the user.

e. The process by which the handbooks will assist the user consists of an explicit matching model that guides the user through a network of questions, rules, and decision nodes. The purpose of the matching model is simply to derive an assessment battery from specific consideration of OWL measurement characteristics, system characteristics, and an operator performance model.

f. The output of appropriate use of the handbooks will be:

- the specification of an optimally effective and practical OWL assessment battery.

g. Regarding the use of the output, employing the prescribed assessment battery will permit the user to identify tasks, functions, and mission segments that impose excessive levels of OWL. High levels of OWL can induce operator errors leading to a degradation of system performance. Knowledge of OWL "choke points" will permit the Army to (1) exploit high technology to reduce excessive levels of mental workload through system design, (2) address the allocation of workload-imposing tasks among soldiers and between soldiers and hardware and/or software, and (3) establish procedures for the selection and training of soldiers to minimize the impact of excessive levels of workload.

5. REFERENCE:

None.

6. ALTERNATIVE OR COMPARABLE APPROACHES:

There are no known alternative or comparable approaches. Existing guidance for OWL measurement emphasize one specific method or one specific set of measures. The handbooks under development will tailor a prescribed set of measures to the distinct objectives and capabilities of the user and to specific characteristics of the system.

7. STAGE OF DEVELOPMENT OF THE METHOD:

The guidance to be incorporated in the handbooks is under development and will be validated on three systems selected and approved by the Army. The handbooks will be available for distribution in October 1989.

8. HOW TO OBTAIN:

To obtain more information on the status of this MANPRINT methodology contact the Chief, ARI Field Unit - Ft Bliss, ATTN: PERI-SB (Dr. Christ), P.O. Box 6057, Ft Bliss, TX 79906-0057.

9. COMMENTS:

a. An interim product, "A comprehensive evaluation of existing OWL measures," will be available for distribution in June 1988. This interim product will permit Army personnel to quickly ascertain the potential utility of each existing measure of OWL.

b. Other interim products will be OWL analysis reports for the three specific Army systems that are used as test cases for validating OWL measures. The systems are the Forward Area Air Defense (FAAD) Line of Sight-Forward Heavy (LOS-F(H)) System, the Aquila Remotely Piloted Vehicle (RPV), and the Automated Target Handover System (ATHS). These interim products are expected to be available for distribution in April 1989.

MANPRINT in Requirements Documents

1. OWNERSHIP: Government

2. POC: Mr. John Miles

3. PHONE: Autovon: 284-8917 Commercial: (703) 274-8917

4. DESCRIPTION:

a. This method consists of narrative explanations plus illustrations of what MANPRINT requirements should be placed in requirements documents for a system in development.

b. This method is appropriate for use in drafting MANPRINT statements in both TRADOC and AMC requirements documents. Such documents include: justification of a major system new start (JMSNS), operational and organizational (O&O) plans, required operational capability (ROCs), joint service operational requirements (JSOR), training device needs statement (TDNS), training device requirements (TDR), commercial training device requirements (CTDR), and request for proposal (RFP).

c. The equipment required to use this method is paper and pencil or whatever is the user's typical means of writing.

d. The input necessary for this method is an understanding of:

- what the system is supposed to do
- the minimum levels of system effectiveness and availability necessary to satisfy military criteria.

e. The processing of the information is a cognitive effort.

f. The output of this method is:

- MANPRINT subparagraphs for the requirements documents listed in paragraph 5b above.

g. The output is used to guide the application of MANPRINT to the detailed MANPRINT portions of requirements documents.

5. REFERENCES:

a. Barber, J.L., Jones, R.E., and Ching, H.L.F., and Miles J. L. Jr. (1987). MANPRINT Handbook for RFP Development, (AMC Pamphlet 602-2, September). Alexandria, VA: U.S. Army Materiel Command.

b. Johnson, K. M., Riviello, R., Rossmeissl, P. G., and Shields, J. L.. Development of an analytic framework for the application of MANPRINT in non-developmental item acquisitions (ARI Research Research Report in preparation).

6. ALTERNATIVE OR COMPARABLE APPROACHES:

Kaplan, J.D. and Crooks, W.H., (1980). A concept for developing human performance specifications (Technical Memorandum 7-80, April). Aberdeen Proving Ground, MD: U.S. Army Human Engineering Laboratory

7. STAGE OF DEVELOPMENT OF METHOD:

Completed.

8. HOW TO OBTAIN:

Reference 6a has been sent to the Defense Technical Information Center (DTIC). Reference 6b may be obtained by mailing Commander, U.S. Army Research Institute, ATTN: PERI-SM (Mr. Miles), 5001 Eisenhower Avenue, Alexandria, VA 22333-5600. Reference 7 is available from DTIC (AD No. A084617).

9. COMMENTS:

a. Reference 6a is written primarily for developmental systems. Reference 6b is the plan for the guide that will be written for systems acquired by the NDI process.

b. Reference 7 contains the theory of tying MANPRINT issues to system performance criteria (although the specific term "MANPRINT" did not exist when this document was written).

Future Computer Software

Crew Requirements Definition Subsystem (CRDS) and Methodology

1. OWNERSHIP: Government

2. POC: Dr. Richard E. Christ

3. PHONE: Autovon: 978-4491/5297 Commercial: (915) 568-4491/5297

4. DESCRIPTION:

a. The CRDS is a stand-alone component of the Systematic Organization Design (SORD) method. The computer based CRDS method is applicable for finding and graphically displaying key data points of a personnel-system performance spectrum.

b. The CRDS method is appropriate for assisting in the development of systems architecture and staffing trade-off analysis. The method is applicable from early concept exploration through full scale production and deployment; it will have a greater impact the earlier it is applied in the system acquisition cycle.

c. The equipment required for this method is an IBM compatible PC.

d. The input necessary for CRDS consists of task and performance parameters:

- mission or function task sequencing
- mission or function task dependencies, i.e., those tasks that require the completion of other tasks prior to start-up
- personnel or materiel line item cost and performance information
- an initial assignment of personnel or materiel line item types to tasks.

e. The processing of the information involves the initial calculation of the shortest task performance times at the expense of personnel and other resource requirements. CRDS then finds and examines trade-offs of required task performance scheduling needed to reduce any conflict in time-phased personnel requirements.

f. The output consists of:

- the longest or critical task sequence
- crew loading.

The longest or critical task sequence is the sequence of tasks which must stay on schedule in order to remain within a minimum mission or function performance time.

Crew loading is the required crew as a function of time. In addition, peak demand is shown for each resource type. A 'pert' chart of the mission or function (with graphical path) is given with longest or critical path highlighted. This graphic also may be displayed in a decomposed fashion revealing one resource type at a time, such as a personnel duty position or materiel line item. Task dependencies are clearly shown according to nodes they feed. A Gantt chart (a graphical bar chart showing required tasks relative to time) also is produced. The Gantt chart, in which task overlap is readily apparent, may be decomposed into task time requirements by resource type.

g. With respect to the use of the output, the CRDS method is not limited to crew served systems and has, in fact, been successfully applied to a fire direction center team. Systematic application of the outputs of CRDS may be used to quantify and study the relationships between manpower and personnel availability or capability restrictions and system mission time window restrictions.

5. REFERENCES:

None.

6. ALTERNATIVE OR COMPARABLE APPROACHES:

Schwalm, R.C., Crumley, L.M., Coke, J.S., & Sachs, S.A. (1981). A description of the ARI crew performance model (ARI Research Report 1324, April).

7. STAGE OF DEVELOPMENT OF METHODOLOGY:

The CRDS method currently is applicable to situations requiring multiple and simultaneous application of resources to tasks. CRDS, as a computer-based method, is in a prototyping stage. The final CDRS method will be available for distribution in February 1989. Pilot data exist for use in field artillery systems. With minor training, Army users could apply it interactively for other systems analyses.

8. HOW TO OBTAIN:

To obtain more information on the status or to obtain copies of the CRDS software, contact CHIEF, ARI Field Unit - Ft. Bliss, ATTN: PERI-SB (Dr. Christ), P.O. Box 6057, Ft. Bliss, TX 79906-0057.

9. COMMENTS:

a. The number of person months required to gather input data is sensitive to the state of known or assumed data about the system being studied. Although the best data are those resulting from field trials, data available

from contractor concepts also will serve. Given the assembly of relevant data, CRDS can produce data templates in 30 minutes. Analysis time is sensitive to the state of conceptualization of the system; that is, early on, more what-if excursions may be required. An excursion may be executed in a matter of minutes. Since CRDS runs on a PC, there are no computer operating costs.

b. The simulation which is highly sensitive to many parameters required for early MANPRINT analyses, will be useful in the evaluation of initial system concepts. It can be applied in soldier-machine environments where the resources assigned to tasks may be taken to be simultaneous mental and physical requirements (such as see, hear, turn, push).

c. The trade-offs of required task performance scheduling needed to de-conflict time-phased personnel requirements may be used to help conceptualize new system designs by quantifying the relative performance of system or crew combinations in a system or mission context. Results may be used as inputs to other models.

Methodologies for Planning Unit and Displaced Equipment Training

1. OWNERSHIP: Government

2. POC: MAJ Charles J. Hintze

3. PHONE: Autovon 284-8917 Commercial (703) 274-8917

4. DESCRIPTION:

a. The method resides on an Apple Macintosh computer disk.

b. This method is appropriate for determining the most effective and efficient training method in which effectiveness is defined in terms of population trained, and efficiency is defined in terms of resources consumed. The model analyzes a unit to determine the most effective and efficient training for the members of that unit during each phase of the unit training program, and the optimal location for training depending on the personnel to be trained. The method can be applied to developing systems throughout the acquisition cycle, i.e., from concept development through the fielding of the weapon system.

c. The equipment required to use the method is an Apple Macintosh computer.

d. The input for this method consists of:

- information about the target audience scheduled to receive the new system - location, size, number of new weapon systems to be received, the time the new system is scheduled to be received, and mission requirements.
- characterization of the training required for each organization specific to mission requirements.
- estimation of the training resources required to train each unit with respect to the mission requirements.

e. The processing of the input involves the development of an initial training schedule or baseline case which includes the identification of training requirements, resource requirements, and rates of resource consumption for a single element of the target audience. The baseline case serves as the departure point from which various training alternatives are computed by varying parameters such as location, prepositioning table of organization and equipment (TOE) equipment, and combining selected training components. The model subsequently is applied to each of the alternatives to investigate the relative sensitivities of the resource demands, training duration, and length of unit down time.

f. The output from this method is a training plan for organizations scheduled to receive the new system. The plan includes a training schedule for each organization and the resources required to perform training according to the training plan. The outputs are:

- expected unit readiness down-time
- expected earliest new system unit readiness
- graphical representation of a training plan to include resource distribution throughout the training cycle.

g. The output can be used either as a planning tool or as a technique to evaluate the training effectiveness and resource efficiency of prepared training plans. It has general application to the investigation of resource requirements and distribution as they affect training productivity.

5. REFERENCES:

Draft report "Methodologies for planning unit and displaced equipment training for LHX".

6. ALTERNATIVE OR COMPARABLE APPROACHES:

- early comparability analyses (ECA)

- cost and training effectiveness analysis (CTEA).

7. STAGE OF DEVELOPMENT OF METHODOLOGY:

The method currently is in a prototyping stage. Pilot data now exist for use in light helicopter experimental (LHX) studies. However, the method is applicable to multiple systems and with minor modifications, can be applied to individual as well as collective training.

8. HOW TO OBTAIN:

Contact the Commander, U.S. Army Research Institute, ATTN: PERI-SM (MAJ Hintze), 5001 Eisenhower Avenue, Alexandria, VA 22333-5600.

9. COMMENTS:

a. The cost of use of this method is determined by the number and types of alternatives investigated once the required input data have been assembled. For prototype use, given the establishment of the base case, alternatives were analyzed in approximately two person hours.

b. The model is rapid and flexible, which allows alternative training plans to be investigated and compared quickly without extensive cost. When used in a building block mode, the model can be applied to determine the hourly consumption of resources for a single set of courses at a service school as well as the requirements for a multi-year program such as the fielding of a new weapon system.

Systematic Organizational Design (SORD)

1. OWNERSHIP: Government

2. POC: Dr. Richard E. Christ

3. PHONE: Autovon: 978-4491/5297 Commercial: (915) 568-4491/5297

4. DESCRIPTION:

a. SORD is an ongoing developmental effort which will produce an integrated, objective method for specifying the composition of Army units and the combination of heterogeneous units necessary to form larger organizational structures that meet the requirements imposed by new high-technology hardware and software systems, changing doctrinal concepts and mission requirements, and constraints in available personnel and materiel assests.

b. The method will be appropriate for use in: (1) translating mission statements into a set of required quantified functional characteristics, (2) building a unit comprised of personnel and materiel assets that have the required capabilities, (3) defining the requirements for allocating materiel and organizational tasks to personnel, and (4) assessing the efficacy of the resulting crew or unit design. SORD will have its greatest impact on the manpower and personnel domains of MANPRINT, but also will have strong implications for training and for the human factors engineering issue of the soldier-machine interface. The methodology will produce for any Army organization, a unit design, i.e., a detailed unit reference sheet, based on an assigned mission. In the process, any appropriate mix of materiel systems and personnel may be assigned to the unit. SORD is employable for any materiel system or military occupational specialty (MOS) at any point where their capabilities can be defined, i.e., at the earliest stages of their conceptual development.

c. The equipment required to use this method is an IBM compatible PC.

d. The input necessary for this methodology consists of:

- mission area specific knowledge relevant to designing a force structure such as that obtainable from subject matter expert.

e. The processing of information is fully interactive with the user. Guidance and data available from Army regulations and data bases are provided in the software and are automatically incorporated into the design of a unit by default. The user can override such a default. Based upon different sets of assumptions provided by the user, SORD will create alternative designs for a unit and then assist the user in a comparison of these alternative designs.

f. The output of SORD consists of:

- alternative mission-driven designs for a unit
- a complete audit trail that will facilitate trade-off analyses.

g. The output of SORD can be used to aid combat developers in identifying and resolving trade-offs between (1) design features of the materiel and organizational systems, and (2) manpower, personnel, and training issues. Furthermore, SORD will make the design of fully mission capable table of organization and equipment (TOE) units more efficient by reducing the waste occurring in the current manual development process. Overall, this method will (1) ensure standardization in the mission analysis and unit design process, and (2) provide a highly detailed and standardized input to the TOE documentation process.

5. REFERENCES:

None.

6. ALTERNATIVE OR COMPARABLE APPROACHES:

None.

7. STAGE OF DEVELOPMENT OF THE METHOD:

SORD is under development.

8. HOW TO OBTAIN:

To obtain more information on the status of SORD contact Chief, ARI Field Unit Ft. Bliss, ATTN: PERI-SB (Dr. Christ), P.O. Box 6057, Ft. Bliss, TX 79906-0057.

9. COMMENTS:

a. The fully integrated SORD method is expected to be available for distribution in February 1989.

b. A stand-alone version of the crew requirements definition subsystem will be available for field use in February 1989.